

## CLAIMS

1. Use of a phosphorus containing polymer to control metal soap formation.

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2. Use as claimed in claim 1 in which the phosphorus containing polymer has a phosphonate or phosphinate end cap.

3. Use as claimed in claim 2 in which the end cap polymer is of  
10 formula (I):



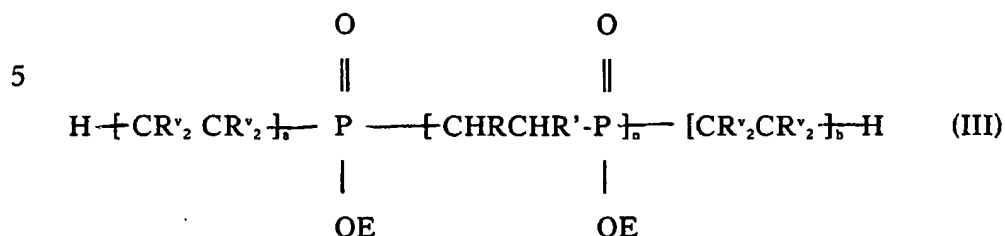
wherein X is H or an alkali metal, alkaline earth or other polyvalent  
15 metal, ammonium or an organic base, and R is a polymeric chain comprising between 1 and 100,000 groups, said group or groups being derived from at least 1 unsaturated compound in which the multiple bond is activated chemically by an adjacent electron withdrawing group, and Y and Z are each hydrogen, a  $PO_3A_2$ ,  $SO_3A$  or  $CO_2A$  group wherein A is  
20 hydrogen or an alkyl or aryl moiety.

4. Use as claimed in claim 3 in which R is a polymer of acrylic acid.

5. Use as claimed in claim 3 in which R is a polymer of a carboxylic  
25 or sulphonic acid selected from the group consisting of methacrylic acid, maleic acid, vinyl sulphonic acid and 2-acrylamido-2-methylpropane sulphonic acid.

6. Use as claimed in claim 3 in which R is copolymer of VPA (vinyl  
30 phosphonic acid) and VDPA (vinyl diphosphonic acid).

7. Use as claimed in claim 1 in which the phosphorus containing polymer is a telomer of formula (III):

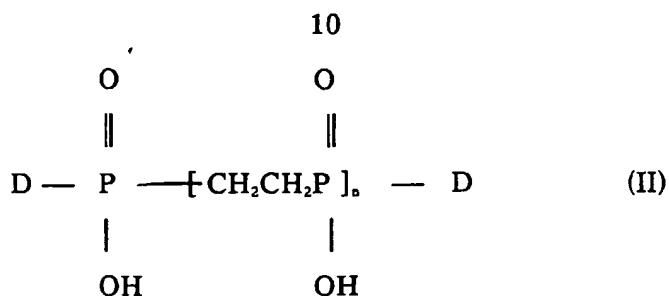


10 wherein E is hydrogen or a cation, R and R' are each independently selected from the group consisting of hydrogen, hydroxyl, carboxyl, alkyl, aryl, alkaryl, hydroxy-substituted alkyl, aryl or alkaryl and carboxy-substituted alkyl, aryl or alkaryl, provided that R and R' together have a total of less than 23 carbon atoms, at least one R<sup>v</sup> in each  
 15 monomer unit is selected from the group consisting of hydroxy, carboxy, sulpho, phosphono, amido, aceto, aryl and halogen;

each other R<sup>v</sup> is independently selected from the group consisting of hydrogen, C<sub>1-4</sub> alkyl, carboxyl, sulpho, phosphono, hydroxyl groups,  
 20 carboxy-substituted, sulpho-substituted, phosphono-substituted and hydroxy-substituted C<sub>1-4</sub> alkyl groups;

(a + b) is in the range 5 to 200 and n is greater than 1.

25 8. Use as claimed in claim 7 in which the telomer of formula (III) is produced by co-polymerising a polymer of formula II with at least one monomer of formula CR<sub>2</sub>'=CR<sub>2</sub>', wherein R' has the same meaning as in claim 7 and wherein formula (II) is:



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wherein D is hydrogen or a cation or an alkyl group and n is 1.05 to 100.

9. Use of a soap control agent as claimed in any of claims 1 to 8  
10 wherein the use is to remove metal ions from a medium.

10. Use as claimed in claim 9 in which the medium is crude oil.

11. Use as claimed in claim 9 in which the medium is a mixture, in any  
15 proportion, of hydrocarbons containing naphthenic or fatty acids with water.

12. Use as claimed in claim 11 in which the water is injection water,  
reservoir water (connate water) water from oil fields, or water from any  
20 system where water contacts or is in contact with crude oil or naphthenic acid or fatty acid containing fluids.

13. Use as claimed in claim 9 in which the medium is selected from  
process soaps and cleaning formulations used in personal home care  
25 applications.

14. Use as claimed in any one of claims 9 to 13 in which the metal ions  
are selected from  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Na}^+$ ,  $\text{Fe}^{2+}/\text{Fe}^{3+}$ .

15. A method of removing metal ions from a medium comprising contacting the medium with an effective amount of a phosphorus containing polymer.

5 16. A method as claimed in claim 15 in which the phosphorus containing polymer has a phosphonate or phosphinate end cap.

17. A method as claimed in claim 16 in which the end cap polymer is of formula (I):

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wherein X is H or an alkali metal, alkaline earth or other polyvalent metal, ammonium or an organic base, and R is a polymeric chain  
15 comprising between 1 and 100,000 groups, said group or groups being derived from at least 1 unsaturated compound in which the multiple bond is activated chemically by an adjacent electron withdrawing group, and Y and Z are each hydrogen, a  $PO_3A_2$ ,  $SO_3A$  or  $CO_2A$  group wherein A is hydrogen or an alkyl or aryl moiety.

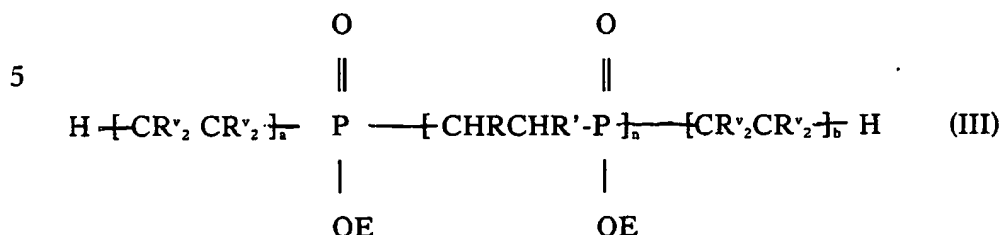
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18. A method as claimed in claim 17 in which R is a polymer of acrylic acid.

19. A method as claimed in claim 17 in which R is a polymer of a  
25 carboxylic or sulphonic acid selected from the group consisting of methacrylic acid, maleic acid, vinyl sulphonic acid and 2-acrylamido-2-methylpropane sulphonic acid.

20. A method as claimed in claim 17 in which R is copolymer of VPA  
30 (vinyl phosphonic acid) and VDPA (vinyl diphosphonic acid).

21. A method as claimed in claim 15 in which the phosphorus containing polymer is a telomer of formula (III):



10 wherein E is hydrogen or a cation, R and R' are each independently selected from the group consisting of hydrogen, hydroxyl, carboxyl, alkyl, aryl, alkaryl, hydroxy-substituted alkyl, aryl or alkaryl and carboxy-substituted alkyl, aryl or alkaryl, provided that R and R' together have a total of less than 23 carbon atoms, at least one R<sup>∨</sup> in each  
 15 monomer unit is selected from the group consisting of hydroxy, carboxy, sulfo, phosphono, amido, aceto, aryl and halogen;

each other R<sup>∨</sup> is independently selected from the group consisting of hydrogen, C<sub>1-4</sub> alkyl, carboxyl, sulfo, phosphono, hydroxyl groups,  
 20 carboxy-substituted, sulfo-substituted, phosphono-substituted and hydroxy-substituted C<sub>1-4</sub> alkyl groups;

(a + b) is in the range 5 to 200 and n is greater than 1.

25 22. A method of removing metal ions substantially as described herein and with reference to the accompanying example.

23. The use of a phosphorus containing compound as a soap control agent substantially as described herein and with reference to the  
 30 accompanying example.

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24. A method of removing metal ions from a medium to control soap formation substantially as described herein with reference to the accompanying example.

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